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09/841,817	04/24/2001	Chih-Ning Wu	JC-6987-C	6297

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CHARLES C.H. WU & ASSOCIATES  
Suite 710  
7700 IRVINE CENTER DRIVE  
Irvine, CA 92618-3043

9  
EXAMINER

KORNAKOV, MICHAIL

ART UNIT

PAPER NUMBER

1746

DATE MAILED: 09/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/841,817

Applicant(s)

WU ET AL.

Examiner

Michael Kornakov

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 09 July 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 10-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 4-9 is/are rejected.
- 7) ☒ Claim(s) 2 and 3 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### DETAILED ACTION

1. Claims 1-20 are pending, claims 10-20 are withdrawn from consideration.
2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
3. Claims 1, 4, 8 and 9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants' admission in view of Tamaoka et al (U.S. 6,232,237), and further in view of Bowden et al (U.S. 5,320,709).

Applicants discuss conventional cleaning method of the dual damascene opening. The said opening is formed by etching the dual damascene structure generally having conductive wire and low-k dielectric layer. Particularly, the dielectric layer 106 and cap layer 104 are etched, thus exposing the metal layer 102. The material of the cap layer is **silicon nitride** (Specification, page 1, lines 15-23; page 2, lines 1-5; Fig.1). The conventional cleaning method of dual damascene opening, disclosed by Applicants, includes the step of wet treatment the dual damascene opening followed by argon sputtering step to bombard the metal oxide for removing the polymer residue before the second metal layer fills in the dual damascene opening 108. In the wet treatment step amine-based organic solvent is utilized (Specification, page 2, lines 11-14). Thus, Applicants admission of the prior art meets the limitations of the claimed process in terms of its steps.

The admitted prior art method differs from the instant claims by reciting an amine based organic solvent vs. fluorine-based organic solvent used in the post-etching cleaning step.

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Tamaoka teaches forming an opening in the semiconductor structure, which comprises the layers of dielectrics and conductive materials, among them silicate based low k dielectric, and interconnection metal layer. (Fig. 3 E-3G, col. 5, lines 12-41).

Tamaoka specifically indicate that during the conventional cleaning with organic cleaner, such as an organic solvent containing an amine group, part of the low k layer exposed on the side wall of the via hole is unintentionally etched to form concave portions, which complicates further processing (col.6, lines 50-64), thus motivating the skilled artisan to utilize the cleaning process without the drawbacks of amine-based organic solvents.

Bowden teaches an improved method for selectively removing of residues from vias, i.e. from pathways connecting layers in a multi-layer chip pattern (col.1, lines 49-52). Bowden utilizes anhydrous ammonium fluoride dissolved in polyhydric alcohol (col. 2, lines 61-65). This reads on the limitations of the instant claim 1, read in light of the instant specification, and on the limitations of the instant claim 3.

Since Tamaoka discredits amine based solvents for post-etching cleaning of vias with exposed metal line and low K dielectric material, and since Bowden teaches a method for selectively removing organometallic and organosilicon residues from vias with the use of specific fluorine based organic solvents, a person skilled in the art, motivated by teaching of Tamaoka and Bowden, would have found it obvious at the time the invention was made to utilize anhydrous ammonium fluoride dissolved in polyhydric alcohol of Bowden, in lieu of amine solvent in the process of Applicants' admitted prior art, in order to avoid etching of low K dielectric material during the

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cleaning procedure, and to ensure the removal of unwanted residues and oxides from exposed damascene structures, and thus to arrive at the instantly claimed subject matter.

Claims 6 and 7 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants' admission in view of Tamaoka et al (U.S. 6,232,237), further in view of Bowden et al (U.S. 5,320,709), and further in view of Denning (U.S. 6,187,682).

Combined teaching of Applicants' admission in view of Tamaoka and Bowden discloses the process identical to the instantly claimed process, but does not specify numerical parameters of sputtering, as per instant claims 6 and 7.

Denning utilizes argon sputtering in a process of cleaning a dual damascene opening having exposed layers identical to those instantly claimed (paragraph, bridging col.8 and 9, Fig. 8, 9). A sputtering power for accelerated cleaning of such structure according to Denning can be 300-500 W (col.5, lines 30-50), thus disclosing the end point of the range identical to the end point of the claimed range. Therefore, a person skilled in the art would have it obvious to utilize the range of power, as suggested in Denning in order to remove contaminants from the dual damascene structure in timely manner in the analogous cleaning step of the above combination of references with the reasonable expectation of success.

With regard to the limitations of claim 7 concerned with the time of sputtering, Denning provides a clear motivation to optimize the time in order to get satisfactory level of cleaning (col. 8, lines 24, 25), thus recognizing time as a result effective parameter. It is also held by the Courts that discovery of optimum value of result effective variable in

known process is ordinarily within the skill in the art and would have been obvious, as per *In re Boesch and Slaney* 205 USPQ 215 (CCPA 1980).

Claim 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants' admission in view of Tamaoka et al (U.S. 6,232,237), further in view of Bowden et al (U.S. 5,320,709), and further in view of Honda et al (U.S. 6,361,712) and as evidenced by Fang et al (U.S. 6,293,848).

The combined teaching is silent about the use of chelating and oxidizing agent, as per instant claim 5.

Addition of chelating and oxidizing agents into post-etch cleaning compositions is routinely used in the art.

Thus, Honda discloses a composition for selective removal of oxides, remaining after plasma etching of a substrate, having low k dielectrics and conductive wires, wherein the silicon nitride layer is positioned between the low k film and the metal wire (col.1, lines 7-10; col. 3, lines 47-49). The composition of Honda comprises **fluorine containing compound**, which can be of organic nature or ammonium fluoride (col.2, line 63; col. 3, line 6), water miscible organic solvents (col.3, lines 39, 49-54) and additives, such as **chelating compounds**, which enhance the effectiveness of cleaning composition of Honda in removing particulate and/or metallic contaminants from the wafer surface (col.3, lines 55-59) without damaging the low-k interlayers.

Since the process of Honda is analogous to wet cleaning step, described by a combination of references and to a wet cleaning step of the instant claims, and since it can be applied to damascene structures, it would have been obvious to a person skilled

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in the art, motivated by disclosure of Honda at the time the invention was made, to add the chelating agent of Honda in a cleaning composition of applied prior art in order to enhance removal of particulate and metallic residues by complexing metal ions with chelating agents.

The rationale for attributing the same compounds to chelating and oxidizing agents, as evidenced by Fang, is discussed supra and is incorporated herein in its entirety.

Therefore, the combination of admitted prior art and applied references renders the instant claims prima facie obvious and properly rejected under 35 U.S.C. 103 (a).

#### ***Allowable Subject Matter***

4. Claims 2 and 3 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The prior art references applied for the rejection of base claim 1 do not teach or suggest fairly the fluoride acetate acid as a principal solvent. The reference to Wu U.S.

6,440,873 was previously applied for the rejection to show the use of such solvent.

However, Applicant **has provided evidence** on this record showing that the invention was owned by, or subject to an obligation of assignment to, the same entity as U.S.

Patent 6,440,873 at the time this invention was made. Accordingly, U.S. Patent

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6,440,873 is disqualified as prior art through 35 U.S.C. 102(e), (f) or (g) in any rejection under 35 U.S.C. 103(a) in this application.

### ***Response to Arguments***

5. Applicant's arguments filed July 09, 2003 have been fully considered but they are not persuasive.

**Relative to Tamaoka:** Applicants' argument resides in contention that Tamaoka "... merely discloses **drawbacks** of the post-ashing cleaning step by using organic solvent containing and amine group".

Thus Applicants themselves admit that such teaching exists, no matter, whether preferred, less preferred or even non-preferred, but constructively present. The teaching to Tamaoka was used to show that the use of amino containing solvent in the similar process presents significant problems.

**Relative to Bowden:** Applicants admit in their response, Paper No. 8, page 4, lines 1-5 that Bowden utilizes a solution of anhydrous ammonium fluoride in a polyhydric alcohol on the photoresist after plasma etching. And as discussed above and admitted by Applicants Tamaoka shows the drawbacks of using amines in the similar process. Therefore, the skilled artisan would have found it obvious motivated by teaching of Tamoka to replace the undesirable amino containing solvent for ammonium fluoride in polyhydric alcohol, as per Bowden in order to avoid etching of low K materials and at the same time to ensure the removal of unwanted residues and oxides from exposed damascene structure.



**R lative to rejections of claims 5, 6 and 7:** Applicants' arguments are entirely based on alleged patentability of the independent claim 1 and on the statement that none of the applied references remedy the deficiencies of admitted prior art, Tamaoka and Bowden. This is not found persuasive for at least two reasons.

- The obviousness of claim 1 over the prior art is in details discussed in the first Office Action on the merits, in the present communication, paragraphs 3 and 8.
- Examiner has met his burden for establishing prima facie case of obviousness, as discussed in the rejections of claims 5, 6, and 7, and showed how the references to Honda, Denning and Fang remedy the deficiencies of APA, Bowden and Tamaoka. Applicants did not present the evidence or rebuttal that such references indeed do not meet the criteria of obviousness rejection. To the contrary, Applicants provided mere statements that such claims are distinguishable over the prior art only due to their dependency,

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

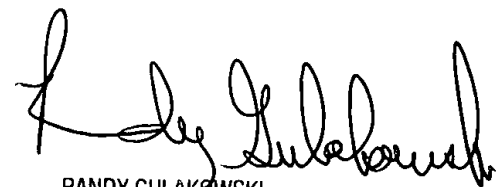
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Kornakov whose telephone number is (703) 305-0400. The examiner can normally be reached on 9:00am - 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski can be reached on (703) 308-4333. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308 2450.

Michael Kornakov  
Examiner  
Art Unit 1746

MK  
September 1, 2003.

A handwritten signature in black ink, appearing to read 'Randy Gulakowski', is written over the printed name and title.

RANDY GULAKOWSKI  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700